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Chief, St/I/R

THRU : Chief, D/S

Chief, S/TR

Requirements on Freight Train Tonnage and Freight Train Speed

BACKGROUND

In connection with the review of EIC R-9, "Capacity of the Trans-Siberian Railroad and Connecting Lines", two major gaps in methodology are the maximum gross freight train tonnage and average freight train speed (another major gap, on the capability of roundhouses, was dealt with in an earlier requirement). It is requested that this requirement be submitted to the same railroads as the previous one on roundhouse capability. It is hoped that responses to this requirement will be received by 1 August 1956.

This background statement is classified Secret. The requirements may be handled as Unclassified if separated from the background statement.

The assumptions and problems apply to a section of railroad similar to that described in the earlier requirement on roundhouses.

REQUIREMENTS

It is requested that the problems be answered in the light of facts given under the "Assumptions". If any estimates must be used to give complete answers to the problems, the estimates should be given, and the reasons for the estimates stated.

A. Assumptions

1. That a maximum amount of traffic must be moved over a railroad line during a period of two years and probably longer.

2. That the line has the following characteristics:

   a. It is a 1215-mile-long section and is part of a longer line
   b. Double track
   c. Track is below average condition
   d. Steam operated
   e. Frequent 1% grades; one section about 8 miles long has 1.74% grade. Maximum curvature of 5.5°.

3. That average temperatures are similar to those in western Canada: January average, -5°F; July average, 60°F. Winter snowfall is moderate.

4. The locomotives have the following characteristics:

a. As many locomotives are available as can be handled by the locomotive stalls.
b. The locomotives used are decapods (2-10-0), with 51,776 pounds starting tractive effort.

5. That unlimited trained manpower is available.

6. That the locomotive repair facilities have the following characteristics:

a. The 1215-mile-long section has a total of 175 locomotive stalls in 15 roundhouses (including some backshops).
b. About half of the 15 roundhouses have a large number of stalls, and are home terminals for locomotives; the remainder of the 15 roundhouses have a small number of stalls, and are turnaround terminals. One of the small roundhouses cares for helpers at the bottom of the 1.74 percent grade.
c. Sufficient equipment and spare parts are available.
d. Roundhouses (and backshops) perform the following: running repairs; boiler washing and related repairs; and medium, or intermediate, repairs. Capital repairs are performed at locomotive heavy repair plants and hence do not tie up backshop space.

7. Locomotive boiler water is soft, or is properly treated to reduce hardness.

B. Problems

It is recognized that if a locomotive is pulling a maximum tonnage, it will have to move very slowly, while with increasing speeds the tonnage it can pull must be reduced. It is also recognized that there is an optimum speed at which tonnage times speed results in a maximum ton-miles produced per operating locomotive day. Furthermore, it is recognized that winter has an effect on both tonnage and speed. The following questions are intended to determine the year-around maximum ton-mile production under the conditions described in "Assumptions", above.

1. Using the described decapod locomotive, which is assumed to be the standard freight locomotive, please answer the following:

   a. At what average train tonnage and what average running speed would an operating locomotive perform a maximum of ton-miles?
   b. Give answers in 1.a. above both for single headed and double headed locomotives on the 1% grade sections; and for single headed, double headed (or single headed plus pusher), and double headed plus pusher on the 1.74% grade.
   c. Give answers in 1.a and 1.b. for both January and for July.

2. The described decapod locomotive has a tender with water capacity of 7,396 gallons, and coal capacity of 12 short tons. Firebox heating surface is 198 sq. ft.; total heating surface, 2,430 sq. ft.; superheater heating surface, 803 sq. ft. Fire grate area is 64 sq. ft. Considering both summer and winter operations, and the train tonnage and speed given in 1. above, what would be the best spacing of water and cooling facilities? How often would the locomotives have to stop for water and coal between their home and turnaround terminals? Under conditions of maximum traffic, what would be the average time spent by a locomotive for water and cooling stops on its run?

3. Given the average running speed in paragraph 1. above, the number of coal and water stops between home and turnaround terminal, and estimating the number and length of other stops, what would be the average freight train speed, including all stops, between the locomotive's home and turnaround terminal? How would this speed vary between summer and winter?

4. What would the average layover of a train be at the home or turnaround terminal, including time for changing locomotives (including delays awaiting locomotives), inspection, and other delays?

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